Jacobs School of Medicine and Biomedical Sciences
University at Buffalo

EXPERT REPORT

ISSUE: **Health Impacts from the Reuse of Single-Use Catheters**

BY: **Ezekiel Young, MD, Director of Pediatric Urology**
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Introduction - I was requested to review medical records and documents relating to a New York State Department of Corrections policy that required paralyzed wheelchair bound inmates to reuse single-use catheters during their incarceration in various penitentiaries throughout New York State. I understand that the inmates filed a lawsuit against the State of New York on various grounds including personal injury related to an elevated incidence of urinary tract infections in these inmates. I have reviewed medical records, opposing opinions, manufacturer recommendations, inmate grievances, and medical review articles related to this case. Based on this review I have outlined my professional opinion on these matters in the four sections below, as well as a fifth section that includes sections taken from the most recently published review article related to the topic.

Expert Qualifications - I am the Director of Pediatric Urology at John R. Oishei Children's Hospital and a Clinical Professor in the Department of Urology at the University at Buffalo Jacobs School of Medicine & Biomedical Sciences. My qualifications and extensive list of publications are further included on my attached curriculum vitae. In the past four-years, I have not testified as an expert at trial or by deposition.

Compensation - As compensation for the preparation of this report, I was compensated at the rate of $500/hr with a budget of $3,000.

I. ACCEPTED STANDARD OF MEDICAL PRACTICE RELATED TO THE USE OF CATHETERS

The well-known and standard practice of clean intermittent catheterization is to utilize single-use disposable catheters, and not to wash and reuse catheters.

A. Universal Standard - The overwhelming majority of urologists throughout the United States, as well as the rest of the industrialized world, prescribe and recommend for patients who require catheterization, to do so using

single-use disposable catheters. This standard does not under any circumstances include a recommendation to wash and reuse catheters.

B. Widely Known and Practiced - The single use standard is widely known, accepted, and acknowledged throughout the Urologic community.

- Catheters are Designed and Manufactured for Single Use - Out of the hundreds of different brands and types of intermittent catheters manufactured throughout the world, virtually all are designed and manufactured with the intention to be used just a single time and then disposed of. I am not aware of a single manufacturer producing multi-use intermittent catheters.

- Insurers Reimburse for Single Use - Medical insurers in the United States, both public and private, fully reimburse for single-use catheters without requiring their subscribers to wash and reuse catheters. If the medical community recommended reuse of catheters, then several, if not most, insurers would certainly deny claims for single-use catheters.

II. REUSING SINGLE-USE CATHETERS IS NOT AN ACCEPTED PRACTICE

The well-established standard of medical practice is the one-time use and disposal of used intermittent catheters. Any policy to the contrary is considered not accepted among medical experts. Therefore, a policy of reusing catheters is not in the best interest of the patient unless exceptional circumstances are present and would require explicit consent of the patient.

- Standard - The one-time use, then disposal of, intermittent catheters is the well-established standard when dealing with patients requiring catheterization. When considering a medical treatment that is both being actively investigated and is considered unsettled and controversial, medical experts recommend utilizing the historic standard treatment until the safety and efficacy of the newer option is fully established and accepted throughout the expert community. Exceptions to this preference are generally only made in exceptional cases where: (1) the traditional and well-accepted standard treatment is *not possible*; or (2) if the newer treatment may offer significant health benefits beyond those offered by the well-established standard. Neither of these exceptions apply to incarcerated individuals.

- An Extreme Minority Opinion - Some limited and controversial studies have claimed no increase in urinary tract infection among those who reuse catheters for clean intermittent catheterization. However, those studies are widely considered unsettled and controversial. There are several important methodological problems with these studies. Because of this,

medical experts have questioned whether these studies should be considered valid at all.

- Multi-Use Environment - All the studies that claimed that re-use of catheters does not increase risk of urinary tract infections examined patients in non-incarcerated settings. No studies have examined the safety of re-using catheters for clean intermittent catheterization within incarcerated settings, where washing of catheters for reuse may be less feasible or less effective.

- Informed Consent -The medical ethic of "informed consent" dictates that when offering or recommending a medical treatment, particularly a new treatment or a treatment that is not considered the "gold-standard" or standard of care, such as the reuse of catheters, the patient should be counseled on the risks, benefits, and alternatives of that treatment. The patient must then explicitly agree to that treatment based on a full understanding of the potential risks and benefits.

- Reuse of Catheters does not meet the Standard of Care - The reuse of catheters is outside of the standard of care and yet it does not appear that the inmates were even given a choice, but rather were forced to use an experimental protocol, outside of the standard of care. This certainly would be considered a gross violation of the ethics of "informed consent."

III. INABILITY TO EFFECTIVELY CLEAN A RE-USED CATHETER

The controversial and unsettled studies on the re-use of catheters fail to address how to effectively clean the catheter for re-use, warranting further disregard for the studies validity.

- No Standard for Reuse - The catheter re-use methods utilized in the above-mentioned studies all describe washing catheters between uses with soap and water. Yet, there is a wide variation in what type of soap could be utilized, or if any specific type is recommended. This fact makes it impossible to make reasonable recommendations for an optimal and safe catheter re-use protocol based on such research.

- Lack of Research on the Impact of Introducing Soaps into the Urinary Tract - There have been no studies demonstrating that the introduction of such soaps into the bladder and urinary tract is safe. Although rinsing the catheters after the application of soap would ideally remove most of the soap material, it is extremely likely that at least a small amounts of the soap material would remain on the catheter and would then be introduced into the bladder upon catheterization.

- Dangers of Reuse - The release of such soaps into the bladder may result in both local bladder reaction as well as systemic absorption, and therefore may be medically hazardous.

- No Studies of Re-Use in an Incarceration Setting - No studies have examined the safety of re-using catheters for clean intermittent catheterization within incarcerated settings, where washing of catheters for re-use may be less feasible or less effective than in other settings.

IV. NEGATIVE SIDE-EFFECTS OF RE-USING A SINGLE-USE CATHETER

Even if future studies were to definitively prove the safety of catheter re-use, the catheters would need to be designed and manufactured specifically with the intention of being used multiple times for them to be safely used in that manner.

- Risks of Re-Use Catheters - The re-use of catheters which have been manufactured specifically for single-use, may result in negative health effects unrelated to urinary tract infections. Examples include, but are not limited to:

    - *Systemic Absorption* - Leaching of plastics, plasticizers, or other catheter coating materials, into the urinary tract with potential subsequent systemic absorption. The systemic absorption of such materials may have both direct toxic effects, long-term carcinogenic effects, as well as potential teratogenic effects on fetal development in pregnant mothers performing catheterization.

    - *Disintegration* - Disintegration of catheters over time with possible deposition of catheter fragments in the bladder or urethra. Such events have been rarely documented even using single-use and indwelling catheters, but would likely be much more common when re-using catheters designed for single-use.

V. RESEARCH IN SUPPORT OF EXPERT REPORT

"Given the benefits of single-use catheters and all the uncertainties with reuse, we believe that repeated use of catheters should not be the preferred method for long-term bladder management."

In further support of the above statement and based on my extensive experience in the field of Urology, I have included quotations taken from the following review article, including the quotation above, published in 2019:

Can Urol Assoc J. 2019 Feb; 13(2): 64–69. Clean intermittent catheterization: Single use vs. reuse, Seyed Hossein Saadat, MD, Shaun Shepherd, MSc, Brandon Van Asseldonk, MD, and Dean S. Elterman, MD. As a review article, the authors went through the full medical literature databases and reviewed all previously published medical studies related to this topic. Based on that review the authors reported the following:

- *"The American Urological Association (AUA) white paper on catheter-associated UTIs provides no recommendation on cleaning the reusable catheters, stating that HC catheters may be preferable to standard UC catheters; nevertheless, as of April 2008, both Medicare and Medicaid fully reimburse for single-use catheters, in the U.S. in quantities that allow for use of a new catheter several times per day. This is consistent with the results of many health-economic studies indicating the cost-effectiveness and improved QoL associated with single-use catheters."*

- *"The European Association of Urology (EAU) recommends aseptic IC for patients with NB. Their definition of aseptic IC refers to genital disinfection and using sterile catheters, instruments, and gloves. Given the difficulty of completely sterilizing catheters at home, and considering the challenge of keeping the sterility with reusable catheters, specifically for neurologically impaired patients, single-use catheters remain the only realistic option."*

- *"The Society of Urologic Nurses and Associates (SUNA) specifically recommends that a new catheter be used for each catheterization. The European Association of Urology Nurses (EAUN) states that the gold standard remains a single-use sterile catheter and highlights concerns about the cleaning efficacy and compliance associated with multiple-use catheters."*

Ezekiel Young, MD

CURRICULUM VITAE

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CURRENT POSITION

Director of Pediatric Urology
John R. Oishei Children's Hospital
University at Buffalo Jacobs School of Medicine and Biomedical Sciences
Buffalo, NY

EDUCATION

Cornell University, Ithaca, NY
Bachelor of Arts in Psychology, September 1995 – June 1999

New York University, New York, NY
Master of Arts in Art Therapy, September 2000 – June 2002

Columbia University, New York, NY
Postbaccalaureate Premedical Program, September 2002 – June 2004

Alpert Medical School at Brown University, Providence, RI
Doctor of Medicine, September 2004 – June 2008

POST-GRADUATE TRAINING

University of Miami Miller School of Medicine, Miami, FL
Chief Resident in Department of Urology, July 2012 – June 2013
Resident in Department of Urology, July 2009 – June 2012
Intern in Department of Surgery, June 2008 – June 2009

Johns Hopkins Medical Institutes, Baltimore, MD
Clinical Fellow in Pediatric Urology, July 2014– June 2015
Research Fellow in Pediatric Urology, July 2013 – June 2014

ACADEMIC APPOINTMENTS

University at Buffalo Jacobs School of Medicine and Biomedical Sciences, Buffalo, NY
Clinical Assistant Professor of Pediatric Urology, January 2020 – Present

Stony Brook University Renaissance School of Medicine, Stony Brook, NY

Clinical Assistant Professor of Pediatric Urology, August 2015 – December 2019

ADDITIONAL LOCUMS TENENS CLINICAL EXPERIENCE

Samaritan Medical Center, Watertown, NY, Intermittently July 2017 – Present

Nemours Children's Specialty Care, Pensacola, FL, July 2017

Nemours Children's Hospital, Orlando, FL, Intermittently July – October 2016

UPMC Altoona, Altoona, PA, Intermittently September 2013 – October 2016

LICENSURE AND CERTIFICATIONS

New York State Medical License # 280645 issued June 24th, 2015
Florida State Medical License # ME128790 (Inactive)
Pennsylvania State Medical License # MD449213 (Inactive)
Federal DEA Registration Originally issued August 8th, 2013
Da Vinci Surgical Robot Training Certification issued October 2011
Society of American Gastrointestinal and Endoscopic Surgeons—Fundamentals of Laparoscopic Surgery
Laser Safety Certification

ADDITIONAL TRAINING

Pediatric Urology Hands-On Robotic Surgery Training Course, Texas Children's Hospital, Houston, TX, March 2014

National Urology Resident Preceptorship in Adult and Pediatric Reconstructive and Prosthetic Urologic Surgery, Glickman Urological and Kidney Institute at the Cleveland Clinic, Cleveland, OH, September 2012.

Robotics Course for the Southeast Section of the American Urologic Association, The Global Robotics Institute, Orlando, FL, October 2011.

EDUCATIONAL LEADERSHIP & OUTREACH

Johns Hopkins Exstrophy Bootcamp 2014: Lead conference organizer

Stony Brook Department of Urology: Pediatric Urology Journal Club Faculty Leader

University at Buffalo, Urology Residency

COMMITTEE SERVICE

American Urologic Association / Society of Pediatric Urology: Pediatric Stone Disease Abstract/Presentation Session Submission Reviewer for Annual Meetings, 2019 – Present.

Stony Brook Renaissance School of Medicine Admissions Committee: Fall 2018 – January 2020

Stony Brook Renaissance School of Medicine Faculty Diversity Ambassadors: June 2018 – January 2020

University at Buffalo & Oishei Children's Hospital, Onco-Fertility / Fertility Preservation Program Planning Committee: June 2020.

University at Buffalo, Urology Residency Faculty Mentorship Planning Committee: June 2020 – Present.

University at Buffalo, Urology Residency, Resident Advancement Committee: 2020 – Present.

Invited Urologist for the National multidisciplinary working group to develop clinical practice guidelines for "minors seeking appearance altering procedures. 2022 – Present.

EDITORIAL DUTIES

Associate Editor for Frontiers in Pediatrics – Pediatric Urology and Pediatric Surgery sections

Reviewer for Pediatrics

Reviewer for Journal of Urology

Reviewer for Journal of Pediatric Urology

Reviewer for Journal of Pediatric Surgery

Reviewer for BMC Urology

Reviewer for Research and Reports in Urology

VOLUNTEER WORK

2019 – Present: Physician volunteer providing pediatric urology evaluation and assessment for 'Connecting Kids with Care.' Connecting Kids with Care is a resource that enables organizations working with orphans and other vulnerable populations to connect with volunteer licensed medical professionals in the U.S. All consultations are provided at no-charge and completed online over the internet.

MEMBERSHIPS

Diplomate of the American Board of Urology: February 28th, 2017 – Present
American Board of Urology, Pediatric Urology Subspecialty Certification: November 2018 – Present
Society for Pediatric Urology, Member, 2013 – Present
American Urological Association, Member, 2009 – Present

LANGUAGES

Proficiency in Spanish

ABSTRACTS AND PRESENTATIONS

1. Mathew S, Coplan J, Mao X, Smith E, **Young E**, Gorman J, Sackeim H, Shungu D. Proton Magnetic Resonance Spectroscopy Correlates of Paroxetine Response in Generalized Anxiety Disorder. Presented at the 42nd Annual Meeting of the American College of Neuropsychopharmacology, San Juan, PR, December 2003.

2. **Young E**, Fitterling H, Mathew S. Barriers to Participation in a Pharmacological Treatment Study of Generalized Anxiety Disorder and Panic Disorder. Presented at the 24th Annual Conference of the Anxiety Disorders Association of America, Miami, FL, March 2004.

3. Harty M, Papa EF, Riley CA, **Young E**, Nazareth S, Ramm GA, Gregory SH, Tracy TF Jr. Kupffer Cell Depletion Alters Matrix Metalloproteinase 8 Expression and Activity During Rat Cholestatic Liver Repair. Presented at the 57th Annual Meeting of the American Association for the Study of Liver Diseases, Boston, MA, November 2006.

4. Harty M, Papa EF, **Young E**, Nazareth S, Gart M, Ramm GA, Gregory SH, Tracy TF Jr. Liver Fibrosis Persists Following Neutrophil Depletion During Liver Repair. Presented at the 58th Annual Meeting of the American Association for the Study of Liver Diseases, Boston, MA, November 2007.

5. Friedman A, **Young E**, Raker C, Anderson BL. Recurrent and Single-episode Pyelonephritis During Pregnancy: A Case-control Study. Presented at the 56th Annual Meeting for the American College of Obstetricians and Gynecologists, New Orleans, LA. *Obstet Gynecol*. 2008, 111(4):31S.

6. **Young EE**, Nguyen B, Weiss-Laxer NS, Sigman M, Nolan P. Factors Associated with Family Planning and Vasectomy Discussions: Results from a State-Wide Health Provider Survey. Presented at the 137th Annual Meeting of the American Public Health Association, Philadelphia, PA, November 2009.

7. Ayyathurai R, Shields J, Kanagarajah P, **Young EE**, Alvarez A, Bird VG. Single Center Clinical Comparison of Two Reinforced Ureteral Access Sheaths for Retrograde Ureteroscopic Treatment of Urinary Lithiasis. Presented at the 75th Annual Meeting of the Southeast Section of the American Urological Association, New Orleans, LA, March 2011.

8. **Young E**, Yates T, Benitez A, Lopez LE, Lokeshwar VB. Anti-Tumor Activity of Sulfated Hyaluronic Acid, a HYAL1 Hyaluronidase Inhibitor, in Prostate Cancer Cells. Presented at the 107th Annual Meeting of the American Urological Association, Washington, DC, May 2011.

9. **Young EE**, Castellan M, Alamsaheb A, Gosalbez R. Anuria and Progressive Renal Failure in a Premature Infant with Bilateral Primary Megaureters. Presented at the 47th Biannual Meeting of the Society for Fetal Urology, Boston, MA, October 2011.

10. Garcia-Roig M, Kiselora K, Yates T, Lokeshwar S, **Young E**, Bird V, Manoharan M, Lokeshwar V. Micro-RNA As a Marker For Renal Cell Carcinoma Metastasis. Presented at the 76th Annual Meeting of the Southeast Section of the American Urological Association, Amelia Island, FL, March 2012.

11. Garcia-Roig M, Kiselora K, Lokeshwar S, Yates T, **Young E**, Kava B, Soloway M, Lokeshwar V. miRNA Expression In Renal Cell Carcinoma Subtypes: Identifying Oncocytoma. Presented at the 108th Annual Meeting of the American Urological Association, Atlanta, GA, May 2012.

12. Garcia-Roig ML, Kiselora K, Yates T, Lokeshwar S, **Young E**, Bird V, Manoharan M, Lokeshwar V. Renal Cell Carcinoma Micro-RNA: A Molecular Determinant of Metastasis? Presented at the 108th Annual Meeting of the American Urological Association, Atlanta, GA, May 2012.

13. Inouye B, Tourchi A, Di Carlo H, **Young E**, Ko J, Gearhart J. Safety and Efficacy of Staged Pelvic Osteotomies in Cloacal Exstrophy Patients. Presented at the 25th Annual Meeting of the European Society of Paediatric Urology, Innsbruck, Austria, May 2014.

14. Inouye BM, **Young E**, Di Carlo HN, Tourchi A, Gearhart JP. The Role of Repeat Pelvic Osteotomy in Classic Bladder Exstrophy. Presented at the 62nd Annual Meeting of the Society for Pediatric Urology, Orlando, Florida, May 16-17, 2014.

15. **Young EE**, Massanyi EZ, DiCarlo H, Inouye B, Gearhart JP, Shimoda LA. Increased α-actin and TGFβ-1 Levels in Bladder Exstrophy Smooth Muscle Cells. Presented at the 72nd Annual Meeting of the Mid-Atlantic Section of the American Urological Association, Baltimore, MD, September 18-21, 2014.

15. Inouye B, Abdelwahab M, DiCarlo H, **Young EE**, Tourchi A, Grewal M, Gearhart JP. Newborn Exstrophy Closure without Osteotomy: Is There a Role? Presented at the 72nd Annual Meeting of the Mid-Atlantic Section of the American Urological Association, Baltimore, MD, September 18-21, 2014.

16. Inouye B, DiCarlo H, **Young EE**, Tourchi A, Gearhart JP. Secondary Re-Closure in Classic Bladder Exstrophy: The Johns Hopkins Experience. Presented at the 72nd Annual Meeting of the Mid-Atlantic Section of the American Urological Association, Baltimore, MD, September 18-21, 2014.

17. Inouye BM, Goldstein SD, **Young EE**, Abdelwahab M, Grewal M, Wildonger S, Stec AA, Gearhart JP. Continence in the Cloacal Exstrophy Patient: What Does it Cost? Presented at the Annual Meeting of the American Academy of Pediatrics, Section on Surgery, San Diego, CA, October 11-14, 2014.

18. Hesh CA, Sirisreetreerux P, **Young E**, Di Carlo H, Gearhart J. Prenatal diagnosis and successful initial closure in classic bladder exstrophy: a single institution experience. Presented at the Annual Clinical Congress of the American College of Surgeons, Chicago, IL, October 4-8, 2015.

19. Tourchi A, Inouye B, Di Carlo H, **Young E**, Gearhart J. Bladder Polyposis in the Setting of Bladder Exstrophy-Epispadias Complex (EEC). Presented at the 26th Congress of the European Society for Paedieatric Urology, Prague, CZ, October 14-17, 2015.

20. Everett, R, Reddy S, Inouye B, Di Carlo H, **Young E**, Abdelwahab M, Gearhart J. The Patient Reported Impact of Pelvic Organ Prolapse on Continence and Sexual Function in Women with Exstrophy-Epispadias Complex. Presented at the 26th Congress of the European Society for Paedieatric Urology, Prague, CZ, October 14-17, 2015.

21. Al-Khalil R, Lee W, Szafran AA, Waltzer W, **Young E**. Robotic-Assisted Laparoscopic Partial Nephrectomy for a Renal Mass in a Two-Year-Old. Presented at the 112th Annual Meeting of the American Urological Association, Boston, MA, May 12-16, 2017.

22. **Young EE**, Hesh CA, Sponseller PD, Di Carlo HN, Gearhart JP. An International Survey of Classic Bladder Exstrophy Management. Presented at the Pediatric Urology Fall Congress, Montreal, Canada, September 8-10, 2017.

23. Chen A, Kapur A, Breutzmann A, Charter T, Hsu E, Weiss-Laxer N, Kim J, **Young E**. Individual and systems level factors associated with odds of orchiectomy in testicular torsion in New York State. To be presented at the 2021 Annual Meeting of the American Urological Association, Las Vegas, NV, September 10-13, 2021.

MANUSCRIPTS

1. Spivey M, Tyler M, Richardson D, **Young E.** Eye Movements During Comprehension of Spoken Scene Descriptions. Manuscript published in the proceedings of the 22nd Annual Conference of the Cognitive Science Society. (pp.487-492). Mahwah, NJ: Erlbaum, 2000.

2. Harty MW, Papa EF, Huddleston HM, **Young E**, Nazareth S, Riley CA, Ramm GA, Gregory SH, Tracy TF Jr. Hepatic macrophages promote the neutrophil-dependent resolution of fibrosis in repairing cholestatic rat livers. *Surgery.* 2008 May;143(5):667-78.

3. **Young EE**, Nguyen B, Weiss-Laxer NS, Sigman M, Nolan P. Factors Associated with Family Planning and Vasectomy Discussions: Results from a State-Wide Health Provider Survey. *Med Health RI.* 2010 Feb;93(2):48-50.

4. Gorin MA, Shirodkar SP, **Young E**, Ciancio G. En bloc mobilization of the spleen, pancreas, and colon during hand-assisted laparoscopic left donor nephrectomy. *Eur Urol.* 2011 Sep;60(3):601-2.

5. Castle SM, Gorbatiy V, Ekwenna O, **Young E**, Leveillee RJ. Radiofrequency ablation (RFA) therapy for renal angiomyolipoma (AML): an alternative to angio-embolization and nephron-sparing surgery. *BJU Int.* 2012 Feb;109(3):384-7.

6. Gahan JC, Gosalbez M, Yates T, **Young EE**, Escudero DO, Chi A, Garcia-Roig M, Satyanarayana R, Soloway MS, Bird VG, Lokeshwar VB. Chemokine and Chemokine Receptor Expression in Kidney Tumors: Molecular Profiling of Histological Subtypes and Association With Metastasis. *J Urol*. 2012 Mar;187(3):827-33.

7. Ayyathurai, R, Shields J, Kanagarajah P, **Young EE**, Alvarez A, Bird VG. Single Center Clinical Comparison of Two Reinforced Ureteral Access Sheaths for Retrograde Ureteroscopic Treatment of Urinary Lithiasis. *Int Urol Nephrol.* 2012 Apr;44(2):409-14.

8. **Young EE**, Castle SM, Gorbatiy B, Leveillee RJ. Comparison of Safety, Renal Functional Outcomes, and Efficacy in Laparoscopic and Percutaneous Radio-Frequency Ablation of Renal Masses. *J Urol.* 2012 Apr;187(4):1177-82.

9. Sun Z, Sinha VR, **Young EE**, Bensadigh B, Ceron C, Kava B, Landon JN, Salgado CJ. The Use of Bovine Collagen and Skin Graft for Reconstruction of the Glans Penis Following Cancer Resection. *Open J Urol*. 2012 Oct; 2(3A), 216-218.

10. Yates T, Knapp J, Gosalbez M, Lokeshwar S, Gomez C, Benitez A, Ekwenna OO, **Young EE**, Manoharan M, Lokeshwar VB. CXCR7: A Functionally Associated Molecular Marker for Bladder Cancer. *Cancer*. 2013 Jan 1;119(1):61-71.

11. Ransford G, **Young E**, Castellan M, Labbie A. Renal pelvis rupture in a kidney with ureteropelvic junction obstruction and extrarenal calyces. *J Pediatr Urol*. 2013 Jun;9(3):e127-30.

12. Inouye BM, Tourchi A, Di Carlo HN, **Young EE**, Mhlanga J, Ko JS, Sponseller PD, Gearhart JP. Safety and efficacy of staged pelvic osteotomies in the modern treatment of cloacal exstrophy. *J Pediatr Urol*. 2014 Dec;10(6):1244-8.

13. Tourchi A, Di Carlo HN, Inouye BM, **Young E**, Gupta A, Abdelwahab M, Gearhart J. Ureteral Reimplantation before Bladder Neck Reconstruction in Modern Staged Repair of Exstrophy Patients: Indications and outcomes. *Urology.* 2015 Apr;85(4):905-8.

14. Inouye BM, Di Carlo HN, **Young EE**, Tourchi A, Gearhart JP. Secondary reclosure in classic bladder exstrophy: challenges and outcomes. *Urology.* 2015 May;85(5):1179-82.

15. Lue K, Gandhi NM, **Young E**, Reddy SS, Carl A, Gearhart JP. The Tunica Vaginalis Flap as an Adjunct to Epispadias Repair: a Preliminary Report. *Urology*. 2015 Nov;86(5):1027-31.

16. Hesh CA, **Young E**, Intihar P, Gearhart JP. The Cost of Failure: The Economic Impact of Failed Primary Closure in Classic Bladder Exstrophy. *J Pediatr Surg*. 2015 Nov 24.

17. Goldstein SD, Inouye BM, Reddy S, Lue K, **Young EE**, Abdelwahab M, Grewal M, Wildonger S, Stec AA, Gearhart JP. Continence in the cloacal exstrophy patient: What does it cost? *J Pediatr Surg*. 2015 Dec 11.

18. Inouye BM, Lue K, Abdelwahab M, Di Carlo HN, **Young EE**, Tourchi A, Grewal M, Hesh C, Sponseller PD, Gearhart JP. Newborn exstrophy closure without osteotomy: Is there a role? *J Pediatr Urol*. 2016 Feb;12(1):51.

19. **Young EE**, Gandhi N, Stuhldreher P, Bishop JA, Wang M. Profound Hematuria in a Toddler Yields and Unusual Diagnosis. *Urology Case Reports*. 2016 May(6):39-41.

20. Goldstein SD, Inouye BM, Reddy S, Lue K, **Young EE**, Abdelwahab M, Grewal M, Wildonger S, Stec

AA, Gearhart JP. Continence in the cloacal exstrophy patient: What does it cost? *J Pediatr Surg*. 2016 Apr;51(4):622-5.

21. **Young EE**, Friedlander D, Lue K, Anele UA, Khurgin JL, Bivalacqua TJ, Burnett AL, Redett RJ, Gearhart JP. Sexual Function and Quality of Life Before and After Penile Prosthesis Implantation Following Radial Forearm Flap Phalloplasty. *Urology*. 2017 Jun;104:204-208.

22. Everett RG, Lue KM, Reddy SS, Friedlander DA, Alexander CE, **Young EE**, Abdelwahab M, Gandhi NM, Wright EJ, Gearhart JP. Patient-Reported Impact of Pelvic Organ Prolapse on Continence and Sexual Function in Women With Exstrophy-Epispadias Complex. *Female Pelvic Med Reconstr Surg*. 2017 Nov/Dec;23(6):377-381.

23. Baumgartner TS, Lue KM, Sirisreetreerux P, Metzger S, Everett RG, Reddy SS, **Young E**, Anele UA, Alexander CE, Gandhi NM, Di Carlo HN, Gearhart JP. Long-Term Sexual Health Outcomes in Men with Classic Bladder Exstrophy. *BJU Int.* 2017 Sep;120(3):422-427.

24. Zaman MH, **Young EE**, Maruf M, Hesh CA, Harris KT, Manyevitch R, Davis R, Wu WJ, Hall SA DiCarlo HN, Gearhart JP. Practice Patterns in Classic Bladder Exstrophy: A Global Perspective. *J Pediatr Urol*. 2020 Aug; 16(4): 425-432.

25. Petit S, **Young E**, Jung I. Systematic Review of Telemedicine in Pediatric Urology. *J Pediatr Urol.* 2022 Feb; 18(1):17-22.

26. Maloney TJ, Loeb C, Waisanen K, Shah R, Weiss-Laxer N, **Young E**. Circumcision Status Regret and Satisfaction: Findings of a United States National Survey. *Sexuality Research and Social Policy*. 2022 Accepted for publication.

REVIEW ARTICLES

1. Inouye BM, Tourchi A, Di Carlo HN, **Young EE**, Gearhart JP. Modern management of the exstrophy-epispadias complex. *Surg Res Pract*. 2014 Jan 5.

2. Tourchi A, Inouye BM, Di Carlo HN, **Young E**, Ko J, Gearhart JP. New advances in the pathophysiologic and radiologic basis of the exstrophy spectrum. *J Pediatr Urology.* 2014 Apr;10(2):212-8.

3. **Young EE**, Brown CT, Merguerian PA, Akhavan A. Pediatric and Adolescent Renal Cell Carcinoma. *Urol Onc*. 2015 Aug 20.

BOOK CHAPTERS

1. **Young EE**, Massanyi EZ, Di Carlo HN, Gearhart JP. Correction of Hypospadias, Epispadias, and Bladder Exstrophy. *Aesthetic and Functional Surgery of the Genitalia*. Editors Salgado CJ, Redett R. Nova Sciences Publishers. pp 207-236. 2014.

2. **Young EE**, Gearhart JP, Inouye BM. Bladder Exstrophy and Epispadias—Modern Staged Approach. *Glenn's Urologic Surgery, 8th Edition*. Editors Graham SD, Keane TE. Lippincott, Williams & Wilkins. pp 846-853. 2015

3. **Young EE**, Gearhart JP. Bladder Exstrophy and Epispadias. *Pediatric Surgery: General Principles and Newborn Surgery, 1st Edition.* Editor: Puri, P. Springer. 2019.

INTERNET CONTENT

1. **Young, Ezekiel**. USMLERx Step 1 Flashcards for First Aid. Edited by Tao Le, Flora Waples-Trefil, & Monica Kumar. Elizabethtown, KY: MedIQLearning, 2007.

INVITED LECTURES

1. Johns Hopkins Extrophy Bootcamp 2016: *Bladder Exstrophy Closure: The Costs of Failure*. May 4, 2016.

2. Johns Hopkins Extrophy Bootcamp 2016: *Complications of Bladder Neck Reconstruction*. May 5, 2016.

3. Southampton Hospital Department of Pediatric Grand Rounds: *Pediatric Urology: Updates for Primary Providers*. May 19, 2016.

4. Stony Brook University Department of Pediatrics Grand Rounds: *Pediatric Urology: Updates for Primary Providers*. June 29, 2016.

5. Stony Brook University Department of Urology Grand Rounds: *Updates on Vesicoureteral Reflux and Ambulatory Pediatric Urology*. October 19, 2016.

6. NYU Winthrop Department of Urology Grand Rounds: *Nephron-Sparing and Laparoscopic Surgery for Pediatric Renal Masses*. June 6, 2017.

7. Stony Brook University Department of Urology Resident Education Series: *Pediatric Urology: High Yield for the Boards: Lecture #1: Baby Problems*. March 26, 2018.

8. Good Samaritan Hospital Medical Center Department of Pediatrics Grand Rounds: *Topics in Urology: Updates for Pediatric Providers*. April 6, 2018.

9. Stony Brook University Division of Neonatology Lunch Lecture: *Updates on Neonatal Urology*. May 22, 2018.

10. University at Buffalo, Department of Pediatrics, Resident Lecture Series: *Oishei Pediatrics Residency Urology Topics Part 1: Normal renal development and obstructive conditions*. March 19, 2020.

11. University at Buffalo, Pediatric Surgery Grand Rounds: *Exstrophy-Epispadias Complex (EEC)*. July 9th, 2020.

12. University at Buffalo, Department of Pediatrics, Resident Lecture Series: *Urology Topics Part 2: Reflux and associated conditions and urethral disorders*. August 6th, 2020.

13. University at Buffalo, Department of Pediatrics, Resident Lecture Series: *Oishei Pediatrics Residency Urology Topics: Penile Anomalies*. April 8, 2021.

14. Buffalo Pediatric Society, Lecture: *Pediatric Urology: Updates for Pediatricians*. April 6th, 2022.

ADDITIONAL DIDACTIC TEACHING

1. Medical Student Virtual Urology Rotation: *Undescended Testes*. June 18th, 2020.

2. Medical Student Virtual Urology Rotation: *Undescended Testes*. July 16th, 2020.

3. University at Buffalo, Urology Residency Educational Sessions: Faculty Mentor, 2020-2022.

Clean intermittent catheterization: Single use vs. reuse

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Abstract

Introduction: Intermittent catheterization (IC) is one of the fundamental aspects of managing patients with chronic urinary retention. Although reuse of catheters has been allowed to be chosen as the first option for IC, the optimal method of IC and the type of catheter has been a long-standing debate. We conducted a literature review regarding risk of urinary tract infection (UTI) and the costs associated with different methods and catheters.

Methods: A MEDLINE search via PubMed, EMBASE, and EBSCO host was conducted in March 2018. The date of publication was limited to 2014 to present/current.

Results: Single use of catheters (hydrophilic-coated [HC] or uncoated [UC]) was considered to impose a lower risk of UTI in all studies, except in one study that included children, but did not test their dexterity to handle HC catheters. Cost-effectiveness of single-use catheters was confirmed by all studies during this period.

Conclusions: Reuse of catheters exposes the patient to a plethora of possible cleaning techniques and duration of catheter use. Patient adherence to cleaning method cannot be predicted and this further amplifies the risk of complications and their burden on the healthcare system. We recommend a patient-centred approach to consider HC catheters as the first option, while considering the patient's/caregiver's ability to accommodate the usage technique. Single-use UC catheters, and finally reuse of catheters are considered as next options if HC catheters are found difficult to handle (especially in children doing self-catheterization). Larger trials investigating this matter are required.

Introduction

Intermittent catheterization (IC) is the recommended technique for bladder drainage in patients with chronic retention resulting from different causes, such as neurogenic bladder (NB).[1] Ever since the landmark paper was published by Lapides et al[2] showing that clean intermittent catheterization (CIC) was possible, it has been widely used and preferred to an indwelling catheter.

For those electing to perform IC, there are two main options: either the traditional reuse of catheters with a form of cleaning between uses or single-use catheterization. Single-use catheters can be either uncoated (UC), such as those made of polyvinyl chloride (PVC), or they can be coated with hydrophilic or gel coverings.[3] The main arguments in choosing between these options are risk of urinary tract infections (UTIs), uncertain cleaning methods, social issues, and finally the cost and quality of life (QoL).[1,4]

Although single-use catheters have been introduced to decrease the risk of urethral trauma and UTI,[5-8] comparing their outcomes with those of reusable catheters can be challenging. The difficulty in making a proper comparison between different methods of catheterization results from inconsistency of the literature regarding study population, UTI definition, type of catheter, cleaning methods, and frequency of catheterization per day. Furthermore, lack of long-term followup makes the decision-making more challenging.[4,9-11] All these uncertainties have led many physicians and patients to reuse catheters.[12]

In 2014, a Cochrane systematic review was published by Prieto et al and supported the reuse of catheters. The authors concluded that multiple uses of a catheter does not impose a higher risk of UTI compared to single use.[13] Since then, not only has more data become available, but also the abovementioned Cochrane review was withdrawn from publication due to an independent appraisal, which identified crucial discrepancies within this publication.[14,15]

In order to draw a conclusion on whether reuse of catheters can still be considered the first option for CIC or not, this literature review was conducted on different IC methods regarding their risk of UTI and their associated costs.

Methods

A MEDLINE search via PubMed, EMBASE, and EBSCO host was conducted in March 2018. The following keywords were used: [("intermittent catheterization*") AND (reuse* OR re-use OR single-use)] or [("intermittent catheterization*") AND (reuse* OR re-use OR single-use)] or [("intermittent catheter*") AND (reuse* OR re-use)] or [("intermittent

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catheterization*") AND (coated OR uncoated)] or [("intermittent catheterization*") AND (coated OR uncoated)] or [("intermittent catheter*") AND (coated OR uncoated)]. The date of publication was limited to 2014 to present/current.

The results were reviewed to select the publications that addressed the relation between IC and clinical UTI or cost/cost-effectiveness/QoL. After removing the duplicates, the non-English articles, the non-systematic reviews/commentaries, and congress presentation abstracts were excluded.

Results

Risk of UTI

Before discussing the risk of UTI, it is important to emphasize the difference between asymptomatic bacteriuria (ABU) and UTI. The former is defined as the presence of bacteria in the urine culture without any urinary tract symptoms, while the latter is a positive bacterial culture accompanied by urinary tract symptoms.[16] Table 1 provides a breakdown of the articles on the risk of UTI associated with different methods of catheterization.

Kanaheswari et al[17] conducted a prospective crossover study among children with neurogenic bladder (n=40) and concluded that a longer duration of catheter reuse resulted in an increased prevalence of ABU, without changing the incidence of UTI. In this study, a comparison was made between weekly and triweekly catheter replacement over nine-week intervals. The 65% ABU noted at baseline increased to 74.2% during the triweekly CIC. This percentage plummeted to 34.2% when the catheter was changed on a weekly basis. There were no symptomatic UTIs over the 18 weeks of study in either group. However, the authors suggested that adherence to the cleaning technique might have been unusually high among the participants, impacting their findings. No comparison to single-use of catheters was made.[17]

A retrospective study by Krassioukov et al[18] surveyed athletes with spinal cord injuries (n=61); they found that those who reused catheters experienced 4±3 UTIs per year, while the figures for single-users stood at only 1±1 UTI(s) per year. This association between catheter reuse and UTI

Table 1. Different methods of intermittent catheterization and associated UTI risk

Method of catheterization (comparator)	Author, date	Age (years)	Outcome	Type/ duration of study	Duration of use before disposal	Frequency of CIC
Duration of use (with multiple use of catheters)	Kanaheswari et al, 2014	1–18	Lower risk of ABU with shorter duration of use (Z-score 6.218; p<0.001)	Prospective 18 weeks	1 week (9 cycles) vs. 3 weeks (3 cycles)	At least 3 times per day
Single use vs. multiple use of catheters	Krassioukov et al, 2015	Paralympic athletes: 16–60	Lower risk of UTI with single use of catheter (p<0.001)	Retrospective (1year data)	2–200 times per catheter	6±2 times per day
Single use vs. multiple use of catheters	Christison et al, 2017*	Not specified	No significant difference	Appraisal of a Cochrane review	Variable	Variable
HC catheters vs. other catheters	Christison et al, 2017*	Not specified	Lower risk of UTI with HC catheters** (p=0.043)	Appraisal of a Cochrane review	Variable	Variable
Single use of HC vs. multiple use of other catheters	Håkansson, 2014	Not specified	Lower risk of UTI with single use HC catheter (20–30%)	Systematic review	Variable	Variable
Single use of HC (SpeediCath) vs. multiple use of PVC catheters	Kiddoo et al, 2015	6–18	Lower risk of UTI with multiple use of PVC catheters (p<0.001)	Prospective cross-over 24-week: HC catheter 24-week: standard PVC	1 day–1 week	3 or more times per day
Single use of HC vs. multiple use of PVC catheters	Rognoni and Tarricone, 2017*	Adult/ adolescent	Lower risk of UTI with single use of HC catheters (p=0.003)	Systematic review	Variable	4–5 times per day
Single use of HC (Lofric) vs. single use of UC	DeFoor et al, 2017	Children with dexterity	Lower risk of UTI with HC catheters (p=0.003)	Prospective RCT (1year)	Advised to use only once	3 or more times per day
Single use HC vs. single use non-HC	Rognoni and Tarricone, 2017*	Adult/ adolescent	Lower risk of UTI with single use of HC catheters (p=0.003)	Systematic review	Single	4–5 times per day
Prelubricated catheters (Instantcath) or those with AMC or those with introducer	Shamout et al, 2017	Adult	Lower incidence compared to standard catheters	Systematic review: 1 study on each topic was found	Variable	Variable

*This study provided two subanalyses and, therefore, has been repeated twice. **After UTI definition was adjusted, the difference between HC catheters and other catheters was no longer significant. ABU: asymptomatic bacteriuria; AMC: anti-microbial coating; CIC: clean intermittent catheterization; HC: hydrophilic-coated; PVC: polyvinyl chloride; RCT: randomized controlled trial; UTI: urinary tract infection.

was statistically significant (p<0.001). Athletes from developing countries experienced higher UTI frequency compared to athletes from other countries (p=0.027). This was explained by the fact that 73% of those from developing countries reused their catheter, while this was the method in only 17% of those from developed countries. The study also showed that catheterization frequency per day did not impact the UTI frequency. Compared to the previous study by Kanaheswari et al,[17] this study might better account for the actual adherence to cleaning practices, simply due to its retrospective design.[18]

The discredited Cochrane systematic review, published in 2014, stated, "There is still no convincing evidence that the incidence of UTI is affected by use of aseptic or clean technique, coated or uncoated catheters, single (sterile) or multiple-use (clean) catheters, self-catheterization or catheterization by others, or by any other strategy."[13,15] The ability of this publication to influence clinical practice raised many concerns, leading to an independent appraisal of this Cochrane review. This re-analysis revealed many flaws and as a result of all the raised concerns, the Cochrane review was withdrawn from publication.[14,15] The reanalysis illustrated that if HC catheters are not considered separately, a small but non-significant trend in favour of single usage vs. reuse of catheters could be found (risk ratio [RR] 0.91;p=0.593). When focusing on HC catheters, the appraisal showed a significant reduction in the incidence of UTI compared to other catheters (RR 0.81; 95% confidence interval [CI] 0.65–0.99; p=0.043).[15] An important consideration to mention is that if UTI definition was to be adjusted for, only two trials (from 1996 and 1999) could be considered for comparing HC catheters with other types and no significant difference was found regarding the incidence of UTI.[14,15]

In the same year (2014), a narrative review of the complications associated with single- or multiple-use catheters was published. This review revealed that single-use HC catheters can reduce the risk of UTI by about 20–30%.[3] Based on the observational studies, this review estimated the risk of UTI to be about 70–80% in those who reused their catheter, while the estimated risk with single-use catheters was about 40–60%, based on review of randomized controlled trials.[3]

Recently, more data has become available comparing HC catheters to other catheters. A prospective crossover trial conducted by Kiddoo et al compared single-use HC catheters and multiple-use PVC catheters in a pediatric and young adult population with NBs.[19] Each treatment period was 24 weeks, for a total duration of 48 weeks. The study showed that the risk of UTI was higher with the single-use HC catheters as opposed to multiple-use PVC catheters (person-weeks of UTI were 3.42±4.67 and 2.20±3.23, respectively; p<0.001) The fact that 52% of the children in this study were self-catheterizing, along with challenges in learning how to use HC catheters might explain the increased person-weeks of UTIs in the HC group and indicates the importance of catheter handling. Another explanation might be that the primary outcome of this study was not based on a standard definition of UTI; UTI was defined as positive leukocytes plus UTI symptoms (instead of positive bacterial culture).[19]

Comparing single usage of HC catheters with reuse of PVC catheters was also addressed in a recently published systematic review by Rognoni and Tarricone in adult and adolescent populations.[20] The frequency of UTI was shown to be lower with HC catheters (RR 0.84; 95% CI 0.75–0.94; p=0.003 for both analyses) and the estimated risk reduction with HC catheters was found to be 16%.[20] The mean age in all of the studies included in this review was above 37 years, which can justify the different results observed by Kiddo et al (mean age 10.6±6.2 years).[19]

A prospective, randomized control trial published in 2017 compared the advantage of HC catheters against single use of UC catheters for one year.[21] Interestingly, children were chosen as the target population, but the differences between this cohort and the population in the Kiddoo et al study[19] is that dexterity testing of both hands was performed in this trial (if the child was self-catheterizing). It was illustrated that HC catheters were associated with a lower risk of UTI, even if the UC catheter was used only once and then discarded (9.1% vs. 51.5% UTIs per person-year; p=0.003). Comparing the UTI rates during the year prior to the study with the rates during the study year showed that the HC group saw a drop from 16% to 5%, although this was not statistically significant. While the number of times that a UC catheter was used before being discarded is not clear in this study, the authors stated, "In our practice, uncoated catheters are 'one-time' use only and patients are never advised to wash and reuse their catheters."[21]

Further comparison of single-use HC and single-use non-HC catheters was addressed in a separate subanalysis of the previously mentioned systematic review by Rognoni and Tarricone. Once again, the frequency of UTI was lower with single-use of HC catheters (RR 0.84; 95% CI 0.75–0.94; p=0.003 for both analyses), with the estimated risk reduction found to be 16%.[20]

Cleaning methods

If reusable urinary catheters are to be used for IC, the method of sanitation becomes particularly important. Several methods have been reported in the literature, including: cleaning with antibacterial soap and water; alcohol sterilization; using aseptic solutions, such as chlorhexidine 1.5% and cetrimide 15%, microwave sterilization; or simply rinsing with water and combinations of these methods.[22-25]

A literature review in 2014 could not recommend a standardized method for cleaning reusable catheters[3] and to our knowledge, no randomized controlled trials have compared

the efficacy of different cleaning methods since then. Although a systematic review published in 2017 referred to two articles that recommended a sterile (aseptic) technique,[26] neither this review nor the Cochrane review provided any statistically significant recommendation on cleaning standards.[13,15]

Cost

The cost of single-use catheters has been one of their main drawbacks for a long time. From the perspective of the public payer, the out-of-pocket cost for these catheters can only be justified if it can offer good value regarding complications, expected life-years, and QoL. It should be emphasized that the QoL is affected by several health-related and non-health-related factors, such as UTI, pain, discomfort, time spent on catheterization, and social factors associated with catheterization. As cost-effectiveness and cost-utility are among the fundamental aspects of health economics, several authors have looked into this matter to assist both patients and policy-makers with their decisions.[27-33]

A cost-comparison analysis by Neovius et al showed that the catheter cost for single-use types was more than that of reusable types (€2188 vs. €817 per year and per patient). However, the annual cost imposed by catheter complications was lower in the single-use group. With the single-use catheters, complications such as UTI, antibiotic-resistant UTI, bacteremia, strictures, and bladder stones resulted in an annual cost of €1243, while the figures for reusable catheters stood at €2067 per patient. In other words, 60% of the extra cost of single-use catheters was compensated.[33]

Watanabe et al[29] studied the cost-effectiveness of HC catheters for bladder management in spinal cord injury (SCI) patients in Japan. They used a modified Markov decision model and addressed direct medical costs, quality-adjusted life years (QALYs) and life years gained (LYG). In contrast to UC catheters, HC catheters resulted in 0.334 QALYs and 0.781 LYG at an incremental cost of ¥1 279 886 ($10 578 USD at an exchange rate of $1 USD=¥121) for HC catheters per SCI patient. The incremental cost-effectiveness ratio (ICER) of HC catheters vs. UC catheters was $31 623 USD/QALY gained and $13550 USD/LYG.

Clark et al published a paper comparing the cost-effectiveness of long-term IC with single-use HC catheters vs. single-use UC catheters.[32] They developed a model based on the results published regarding IC in adults with SCI. UTIs and renal function were considered model health states. Their model predicted the life expectancy of a 36-year-old SCI patient who used HC catheters to be 1.4 years longer compared to those using UC single-use catheters (on average, another 23.9 years with HC catheters and 22.5 years with UC types). When the increased cost of HC catheters was factored in, the ICER was a gain of £6100 for each QALY. This cost is well within the threshold for the National Institute of Clinical Excellence (NICE) in the U.K.[32]

Using a modified version of the model developed in the previous study,[32] cost-effectiveness of HC catheters was addressed in Canada.[27] This model predicted that in a 50-year-old patient with SCI, using HC catheters would lead to living 0.78 years longer and to the gain of an additional 0.72 QALYs compared to using UC. The incremental cost and ICER for this gain was $48 016 CAD and $66 634 CAD/QALY, respectively. Moreover, the lifetime risk of developing UTI in these patients was estimated to be 11% less with HC catheters compared to UC types. The authors concluded that reimbursement of HCIC catheters should be considered in these settings.

A similar study was conducted in Brazil and results were presented as cost per LYG, cost per QALY, and cost per number of avoided UTIs. The results revealed cost-effectiveness of HC catheters compared to UC PVC catheters per LYG (57 432 Brazilian Reais [BRL] equal to $17 773 USD, at an exchange rate of 0.31) and per QALY (122 330 BRL, equal to $37 857 USD). HC catheters showed the potential to reduce the lifetime number of UTIs by 6% at the cost of 31 240 BRL ($9817 USD).[30]

Cost-effectiveness of HC catheters has also been evaluated from the perspective of Italian Healthcare Service system. The base-case incremental cost-effectiveness and cost-utility ratios (ICER and ICUR) associated with HC catheters were €20 761 and €24 405, respectively. This implies that HC catheters are likely to be cost-effective in comparison to uncoated ones, as the proposed Italian threshold values range is between €25 000 and €66 400.[31]

Discussion

Reuse of catheters for the purpose of IC has been popular and widely used. Although this has been more common in developing countries,[18] it has been reported to be practiced by more than 35% of patients in North America.[3] Despite this common use, the evidence on the prevalence of UTIs associated with repeated use of a catheter is conflicting.[9,10,12,34] Aside from questionable cleaning methods, it is unclear how long a multiple-use catheter can be reused. With the level of variation observed across clinical trials, it is likely that similar, if not more variation can be expected in public use. The lack of evidence-based recommendations is sure to confuse the general public and alter their adherence to cleaning methods.[23,24] These facts suggest single use of catheters as a potential remedy. It is also important to consider the effects that cleaning and repetitive uses can have on catheters.[18,22-25]

The American Urological Association (AUA) white paper on catheter-associated UTIs provides no recommendation on cleaning the reusable catheters, stating that HC catheters

may be preferable to standard UC catheters;[4] nevertheless, as of April 2008, both Medicare and Medicaid fully reimburse for single-use catheters, in the U.S. in quantities that allow for use of a new catheter several times per day. This is consistent with the results of many health-economic studies indicating the cost-effectiveness and improved QoL associated with single-use catheters.[30-33]

The European Association of Urology (EAU) recommends aseptic IC for patients with NB. Their definition of aseptic IC refers to genital disinfection and using sterile catheters, instruments, and gloves.[1] Given the difficulty of completely sterilizing catheters at home, and considering the challenge of keeping the sterility with reusable catheters, specifically for neurologically impaired patients, single-use catheters remain the only realistic option.

The Society of Urologic Nurses and Associates (SUNA) specifically recommends that a new catheter be used for each catheterization.[35] The European Association of Urology Nurses (EAUN) states that the gold standard remains a single-use sterile catheter and highlights concerns about the cleaning efficacy and compliance associated with multiple-use catheters.[36]

The current Canadian Urological Association (CUA) recommendations for male and female CIC are to use a catheter for a week or until physical damage is noticed. The wording specifically used for female CIC specifies that "a catheter can be reused and cleaned for about a week or so." This language is vague and leaves much to patient interpretation, the result of which can be unsafe practices. The recommended CUA cleaning protocol is to clean the catheter immediately after use with hand or dish soap and air dry.[37,38] The CUA stands out with recommendations that specifically support the multiple use of intermittent catheters in direct contradiction with what is supported by other North American and European organizations. The recommendation for reuse of single-use catheters also contravenes the Health Canada labelling for single use of these catheters. Considering the emergence of new evidence supporting single-use catheters, the CUA stands alone with the position on multiple catheter use.

Conclusion

Reuse of catheters exposes the patient to a plethora of possible cleaning techniques and duration of catheter use. Patient adherence to cleaning method cannot be predicted and this further amplifies the risk of complications and their burden on the healthcare system. Given the benefits of single-use catheters and all the uncertainties with reuse, we believe that repeated use of catheters should not be the preferred method for long-term bladder management.

Until more data becomes available, we recommend a patient-centred approach to consider HC catheters as the first option, while considering the patient's/caregiver's ability to accommodate the usage technique. Single-use UC catheters, and finally reuse of catheters are considered as next options if HC catheters are found difficult to handle (especially in children doing self-catheterization).

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This paper has been peer-reviewed.

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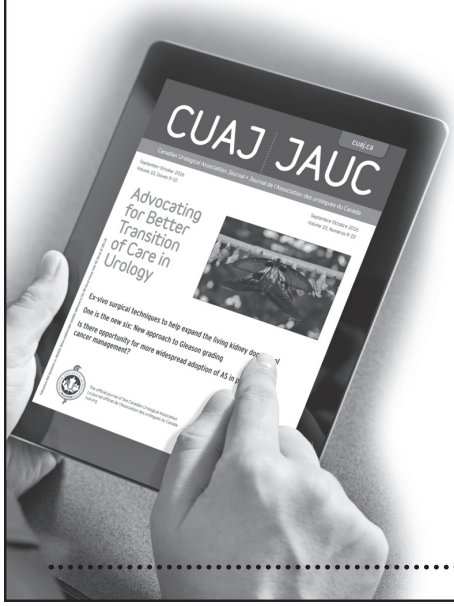

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